



Lesson 3

Oil tanker in Capetown

World Travelers

In this lesson students begin to explore the role transportation plays in the manufacturing of products. Students examine the geographical sources of the raw materials and resources used in a surfboard and learn about typical methods of transportation used to bring materials to factories. Students learn about areas of the world known for their natural resources used in manufacturing.

Using a world map showing major sources of common natural resources, students calculate how many miles the raw materials they need must travel to reach a factory in California. They also make decisions about meth-

ods of transportation (via trucks, trains, airplanes, or ships) to get the materials to their factories, based on point of origin and fuel cost, to help them understand the various factors manufacturers must consider.

Background

Transportation plays a key role in the manufacturing process. To produce common objects, manufacturers move resources—sometimes across great distances—from their sources to

Learning Objective

Describe the methods used to extract, harvest and transport the materials used to make common objects from natural resources.



processing plants to factories. From factories, finished products move to distribution centers to markets to homes. Disposing of used or broken products also requires transportation, from homes to recycling centers, landfills, or second-hand stores.

Manufacturers most commonly rely on road, rail, air, and sea for the transportation of natural resources and products. Each method offers advantages and disadvantages in terms of cost, efficiency, speed, effects on the environmental, and safety. These and other factors help manufacturers determine the proper mode of transportation for each production stage. The need to move perishable items to market quickly may lead a manufacturer toward one transport method, while cost may lead a manufacturer of heavy goods toward another transport method.

The methods used to transport resources and products can alter natural systems. Roads and rails, for example, can fragment open land and affect the habitats of animals and plants. These physical paths create

barriers that prevent or discourage animals from crossing as they roam their territories in search of food. Artificially dredged shipping lanes and harbors built to accommodate large cargo ships influence marine and coastal ecosystems. In addition to causing physical changes to the ocean floor, these shipping pathways also lead to changes in biodiversity under water, when ships unintentionally carry nonnative marine organisms in their ballast tanks and inadvertently release them into new areas. The nonnative organisms can compete with native plants and animals and change the size and distribution of populations. Airports with their long runways and large terminals require a large amount of space. Sometimes airports extend into previously undeveloped land, and the emissions and noise from airplanes can also influence nearby plants and animals. In all such decisions, humans make decisions that relate to the balance between human interests and needs and environmental effects.

With the opening of new markets and the discovery of additional sources of valuable raw materials, manufacturers and distributors increasingly require more routes

and vehicles for transportation of goods. The costs of these new routes and modes transportation, from fuel burned in truck engines to the construction of new airports, usually make their way into the final price of a consumer product.



Key Vocabulary

Cargo: Goods transported by sea (via ships), land (via trucks or train), or air (via aircraft).

Factory: The facility where people and machines manufacture objects.

Market: (noun) A public place where people gather to buy and sell goods. (verb) To make available a specific good or product.

Transport: To carry or move people or things from one place to another.

Transportation: The act of carrying or moving people or things from one place to another.



LNG tanker at Asian liquefaction plant

Toolbox



Summary of Activities

Students refer to a world resources map to identify where resources used in surfboard manufacturing come from. They determine travel distances and select methods of transportation for the raw materials and resources in their toy projects.



Instructional Support

See Unit Resources, page 28

Prerequisite Knowledge



Students should know about:

- major forms of transportation, including trucks, trains, ships, and airplanes.

Students should be able to:

- use multiplication to calculate distances.
- convert distances in inches to miles on a map (scale).

Students should have:

- completed previous lesson.

Advanced Preparation



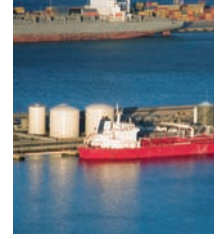
Gather and prepare Activity Masters:

- Gather from previous lessons:
 - Student **Manufacturing and Design Journals** (individual student's copies)

Gather and prepare Materials Needed.

Gather and prepare Visual Aids:

- Prepare transparencies.



Materials Needed



Activity supplies:

- Rulers: one that is clear plastic for the teacher; wood, plastic or metal rulers for the students
- Calculators: one per student; optional

A-V equipment:

- Overhead projector or LCD projector, screen

Class supplies:

- Transparency markers, colored pencils

Visual Aids



Transparencies:

- **A World of Resources**, Visual Aid #7
- **World Bauxite Distribution**, Visual Aid #8
- **World Iron Distribution**, Visual Aid #9
- **World Petroleum Distribution**, Visual Aid #10
- **Modes of Transportation in Industry**, Visual Aid #11
- **World Travelers**, Visual Aid #12

Duration



Preparation Time

15 min.

Instructional Time

60 min.



Safety Notes

None

Activity Masters in the Supporting Materials (SM)

No Activity Masters are required for this lesson.

Procedures

Step 1

Ask students, “What are some of the natural resources used to make the materials for surfboards (from Lesson 2)?” [Wood, petroleum (polyurethane and polystyrene foams, epoxy), silica (glass), bauxite (aluminum), plants (biofoam), graphite] As students share the names of the resources, write them on the white board.

Step 2

Project the transparency of **A World of Resources** (Visual Aid #7) and ask a few volunteers to find on the map where the resources mentioned in Step 1 can be found. Ask students, “Are any of these resources available in California?” (Yes) “Are these resources also available in other parts of the world?” (Yes) Ask students, “If the surfboard factory is in California, why would we want to get the natural resources needed for the board’s components in California?” (*The resources would get to the factory faster, the costs for shipping would be lower than if the resources come from another state or country, jobs to transport the resources would be created for people in California.*)

Step 3

Tell students that sometimes manufacturers cannot find the resources they need close to their factories and that sometimes resources can be less expensive even if they come from farther away. For this reason, many manufacturers go shopping on the world market for the natural resources and raw materials to make their products; by broadening their search for materials, they can find the best materials at the lowest prices. If they choose materials from far away, the manufacturers must then arrange for transportation from the source to the factory.

Project the transparency **World Bauxite Distribution** (Visual Aid #8) and ask students to name continents where bauxite is found. Project the transparency **World Iron Distribution** (Visual Aid #9) and ask students to name continents where iron is found. Project the transparency **World Petroleum Distribution** (Visual Aid #10) and ask students to name continents where petroleum is found. Ask the students which of these three resources are found in California.

Ask students, “How do materials from one part of the world get transported to another part of the world?” (*By truck, plane, ship, or train*) “Which mode of transportation do you think is most used by manufacturers?” (*It depends on where the resources come from.*)

Step 4

Project the transparency of the **Modes of Transportation in Industry** (Visual Aid #11). Ask students, “Why do you think that trucks are used more often than other large vehicles to transport materials and products?” (*There are many roads and highways. Most materials and products are used close to where they are found or manufactured.*)

Step 5

Distribute individual copies of the **Manufacturing and Design Journals** to each student. Have students review the map on page 10 (A World of Resources). Then ask the class to turn to page 12 (World Travelers) and read over the assignment.



Step 6

Project the transparency of **A World of Resources** and talk students through Step 1 on page 12 (World Travelers) in their **Manufacturing and Design Journals**, using the surfboard instead of student toys as an example. Use the map, **A World of Resources**, to locate three natural resources used in the surfboard. (*Petroleum from the Gulf of Mexico, wood from California, and bauxite from Brazil.*)

Project the transparency of the **World Travelers** (Visual Aid #12) and use a transparency marker to write petroleum, wood, and bauxite, on the lines named “Name or natural resource #1-3.” Using petroleum as an example, again project the map, **A World of Resources**, and using the clear plastic ruler, draw a line between the Gulf of Mexico and an imaginary location for the surfboard factory along the California coast. Point students to the Resource Transportation Chart on page 11 of their **Manufacturing and Design Journals**. Ask them to read from the chart the distance that each of the three resources has to travel to the surfboard factory. Write the numbers on the “Distance transported” line below each of the three natural resources. Guide students through the calculations needed to determine the total distance in miles that all three resources for the surfboard must travel to the factory.

Step 7

Explain to students that the distance the class calculated for the transportation of petroleum is just a rough estimate. Tell students that the petroleum used to make the foam for the surfboard may go directly from the Gulf of Mexico to an oil refinery on the Gulf Coast, where it is refined into chemical feedstocks. Then, these chemicals are transported to chemical manufacturers who process the feedstock into polystyrene pellets. Some of these chemical companies may be local and some may be in California or another state. These companies make pellets that are then shipped to a Styrofoam manufacturer, who converts the pellets to Styrofoam planks. These planks, or smaller pre-cut pieces, travel to the surfboard factory in California. The surfboard maker then cuts the Styrofoam planks they receive into the sizes and shapes they need to make their surfboards.

Students should take into account the fact that roads are not straight, like the line drawn from the Gulf of Mexico to California. The distance the class calculated represents the shortest possible distance a resource could travel from source to factory. More realistically, taking into account intermediate processing steps and real transportation routes, a resource must travel double or triple that number of miles.

Tell students that they will be calculating the shortest distances the resources for their toys would have to travel. Project the transparency of the **World Travelers** again and leave it displayed as students complete page 12 in their **Manufacturing and Design Journals** for their own toys.

If needed, distribute calculators and colored pencils for students to use.

Step 8

Review the instructions for Steps 1 and 2 on page 12 (World Travelers) and give students the rest of the class period to complete their work.

Collect **Manufacturing and Design Journals** for use in assessment.

Lesson Assessment

Description

This lesson has students consider methods and factors involved in transporting materials and natural resources for the manufacture of common products. Students learn that these resources and raw materials travel great distances through the manufacturing process. Student work on page 12 (World Travelers) in their **Manufacturing and Design Journals** demonstrates their understanding of the various sources of natural resources, the distances they must travel, and how they are transported around the world.

Suggested Scoring

The students' answers will vary depending on the toy they designed. Review pages 6 and 7 in their **Manufacturing and Design Journals** to see what toy they are thinking of making and the natural resources they would need to manufacture it.

Check to make sure that the natural resources they have listed on World Travelers matches the resources they need for their toy. Give them 1 point for each of the three resources listed correctly.

Using the **Resource Transportation Chart** on page 11 of the **Manufacturing and Design Journals** check the distances that they have entered that each natural resource must travel, give them 1 point for each distance listed correctly.

Review the type of transportation that they have identified for each resource and give them 1 point for each appropriate answer. Answers will vary depending on the resources they have chosen.

Check the students' calculation of the total distance traveled by all three resources and give one point for a correct answer.

A total of 10 points is possible.

Answer Key and Sample Answers

World Travelers

- Step 1:** Write the names of three resources you need to make your toy on the lines labelled Natural Resource #1, Natural Resource #2, and Natural Resource #3.
- Step 2:** Look at the chart on page 11 (A World of Resources). Find your resources on the chart and write the estimated distance on the line labelled Distance transported.
- Step 3:** Circle your choices of how you will transport each resource to California.
- Step 4:** Add all the distances for a total estimate of how far the resources travel.

Name of natural resource #1: Cotton

Distance transported (estimate in miles) = 2125

Type of Transportation Needed (circle one):

Truck Train Aircraft Ship

Name of natural resource #2: Gelatin

Distance transported (estimate in miles) = 150

Type of Transportation Needed (circle one):

Truck Train Aircraft Ship

Name of natural resource #3: Silica/Quartz

Distance transported (estimate in miles) = 150

Type of Transportation Needed (circle one):

Truck Train Aircraft Ship

Total estimated distance all cargo will travel: 2,425 miles

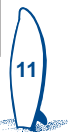


Manufacturing and Design Journal

Resource Transportation Chart

Raw Material Yielded	Source of Materials	Estimated Distance Transported (miles)
Bauxite	Brazil	6510 mi
Clay	California	100 mi
Copper	Arizona	700 mi
Cotton	Alabama	2125 mi
Gelatin	California	150 mi
Graphite	Arizona	700 mi
Iron	Minnesota	1560 mi
Leather	Texas	1540 mi
Limestone	California	200 mi
Petroleum	Texas	1700 mi
Resin (rosin)	China	6500 mi
Rubber (natural)	Venezuela	4306 mi
Silica/Quartz	California	150 mi
Soda ash	Montana	912 mi
Tin	New Mexico	1000 mi
Wood/timber	California	300 mi

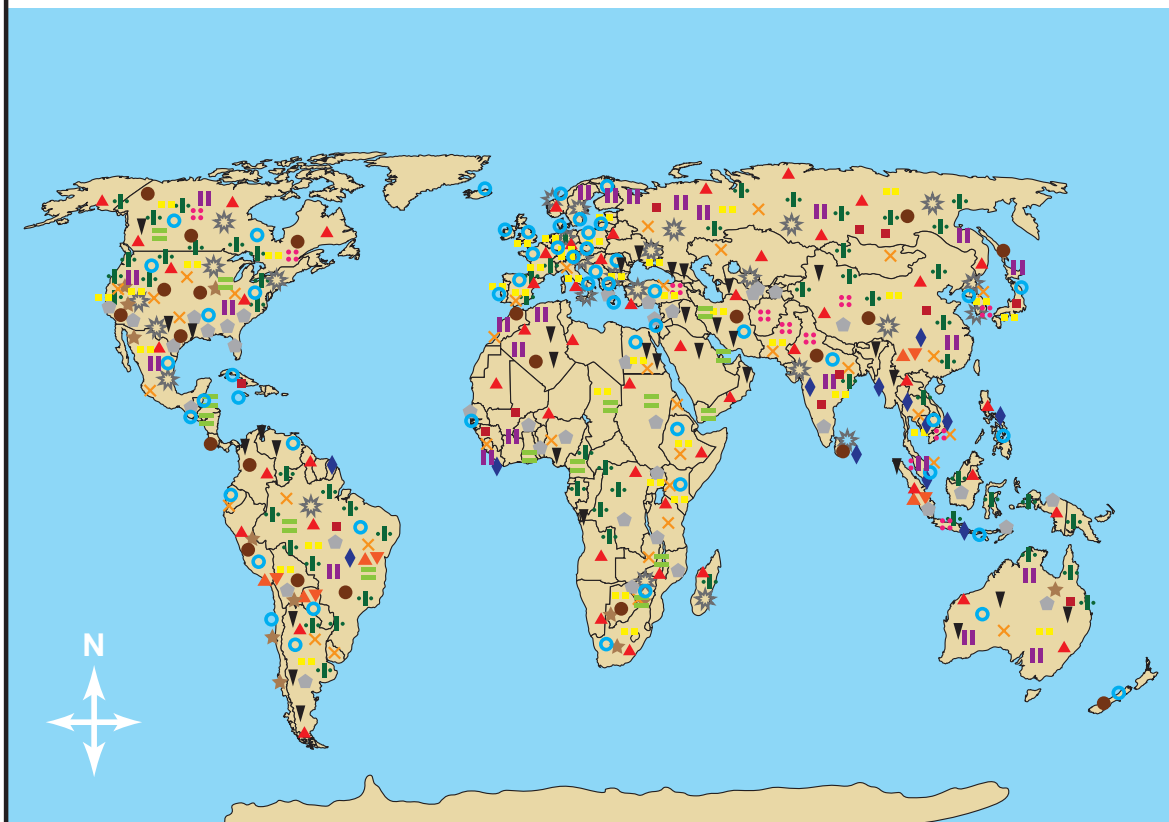
Manufacturing and Design Journal



A World of Resources

Raw Material Key

■ Bauxite	▲ Gelatin	■ Limestone	○ Silica/Quartz
● Clay	★ Graphite	▼ Petroleum	■ Soda Ash
★ Copper	■ Iron	■ Resin (Rosin)	▲ Tin
● Cotton	× Leather	◆ Rubber (Natural)	■ Wood/Timber



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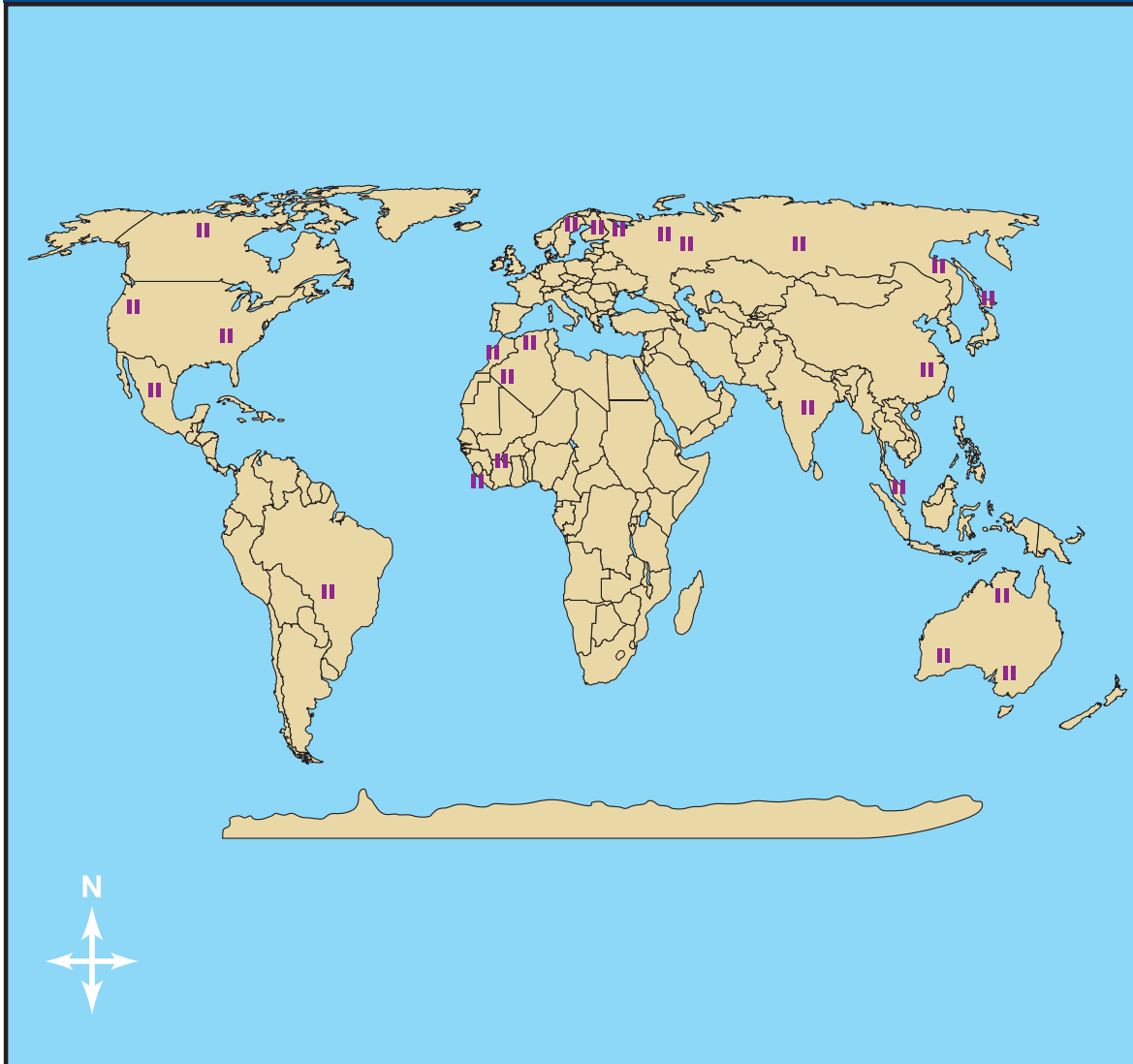
World Bauxite Distribution

Visual Aid — Transparency

World Bauxite Distribution



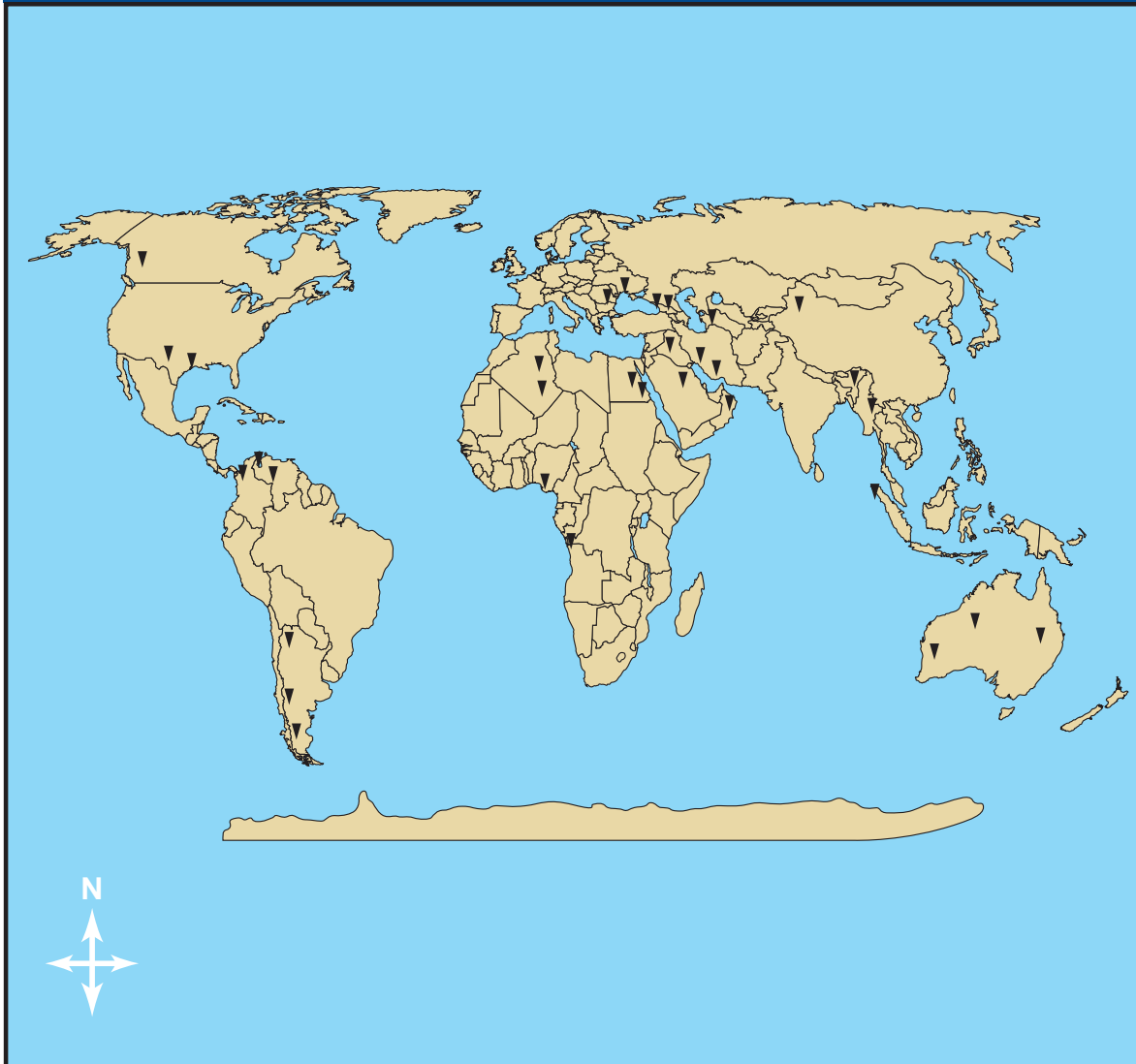
World Iron Distribution



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World Petroleum Distribution

Visual Aid — Transparency

World Petroleum Distribution

Modes of Transportation in Industry

Percent use of large vehicles in industry.



49%



27%



15%



9%

Source: U.S. Department of Energy, *Transportation Energy Data Book: Edition 26-2007*.

Last Revised: October 2007

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World Travelers

Visual Aid — Transparency

World Travelers

Step 1: Write the names of three resources you need to make your toy on the lines labelled Natural Resource #1, Natural Resource #2, and Natural Resource #3.

Step 2: Look at the chart on Page 6 (A World of Resources). Find your resources on the chart and write the estimated distance on the line labelled Distance transported.

Step 3: Circle your choice of how you will transport each resource to California.

Step 4: Add all the distances for a total estimate of how far the resources travel.

Name of natural resource #1: _____

Distance transported (estimate in miles) = _____

Type of Transportation Needed (circle one): Truck Train Aircraft Ship

Name of natural resource #2: _____

Distance transported (estimate in miles) = _____

Type of Transportation Needed (circle one): Truck Train Aircraft Ship

Name of natural resource #3: _____

Distance transported (estimate in miles) = _____

Type of Transportation Needed (circle one): Truck Train Aircraft Ship

Total estimated distance all cargo will travel: _____ miles